

Fama & French Three Factor Model: Evidence from Emerging Market

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Abstract

The main objective of this study is to test the ability of the Fama - French three factor model to explain the variation in stocks rate of return over the period from Jun 1999 to June 2010 in Amman stock market, the study also investigates the existence of the size and value effects. The study found a strong size and strong positive value effects in ASE. The study results indicated that the Fama & French three factor model provide better explanation to the variation in stocks rates of return than the CAPM.

Keywords: The CAPM, The Fama and French, Value effect, Size effect.

1. Introduction

The capital assets pricing model (CAPM) was developed by **Sharpe** (1964), **Lintner** (1965) and **Mossin** (1966). This model aims to answer the question on how we can price one security taking into consideration the risk and the return that this security poses, this principle was developed by **Harry Markowitz** (1952). A vast amount of researches has been conducted to test the validity of the CAPM in explaining the variation in rate of return. However, these studies provide no evidences to support this model (**Ross** (1976) and **Chen et al.** (1986). Motivated by the weakness and limitations of the CAPM, **Fama & French (1992)** motivated by **Banz** study (1981) provided an alternative way to predict stocks' returns, **Fama & French (1992)**, used sample of non financial firm drawn from three major US financial market(NYSE, AMEX and NASDAQ), over the period from 1963 to 1990, **FF** tests the ability of the market beta coefficient, size, E/P, leverage and book to market equity ratio, to predict the cross-section rate of return, they found no relationship between market beta factor and stocks rate of return. Inspired by the results of their previous study, **Fama & French (1993)** developed what become known the Fama & French three factor model.

This paper is organized as follows: Section 2 introduces the related literature. Section 3 discusses the data and methodology. Empirical results are presented in Section. 4. Section 5 Provides the Summary and Conclusions.

2. Literature Review

Many studies have been conducted to test the ability of the Fama & French three factor model to explain and predict the variation in the stocks rate of return, while other studies investigate if the Fama & French three factor model perform better than the traditional capital assets pricing model.

Daniel and Titman (1997) used monthly data over the period from July 1963 to December 1993 for NYSE, AMEX, and NASDAQ stock markets, the finding of Daniel and Titman did not support the Fama & French three factor model, they indicate that the size and book to market equity ratio are both highly correlated with stocks average rate of return. They conclude that the characteristics of these stocks not their risk explain the cross –section stocks return, they also concluded that investors like growth stocks (strong firms) and dislike value stocks (weak firms). They also reported that market beta factor has no explanatory power for stock rate of return. As a response to Daniel and Titman (1997), **Davis et al. (2000)** extended the data set from 1929 to 1997, they indicated that the results of Daniel and Titman (1997) are specific to relatively short data set that they used and the three factor model explain the value premium better than characteristic explanation. They also observed that the value effect is strong in the US stock markets and the relation between average stocks rate of return and book to market equity is positively significant. **Faff (2001)** used monthly data for 24 Australian industries over the period from 1991 to 1999; he investigated the validity of the Fama & French three factor model using Generalized Method of Moments (GMM test). He indicates that for the sample period used, the GMM test provides strong support to the three factor model. He observed a negative relation between size and portfolios rate of return, or in other word the small Australian industries generate average rate of return exceed the return for big Australian industries, he also shows that the relation between risk premium and market return and book to market equity are positively significant. **Drew and Veeraraghavan (2003)** used data from four Asian emerging markets Hong Kong, Korea, Malaysian, and Philippines over the period from 1991 to 1999 in order to investigated the ability of the Fama & French three factor model to explain the variation in stocks average rate of return, they stated that the three factors model have superior power in explaining the average stocks return in all four countries .Using daily data from Australian stock market **Faff (2004)**, provides a test for **FF** three factor model. Using a sample from the industrial sect, the results show that the **FF** provides a convenient assessment to the risk premium. The results also indicate that the three factors model still better than the CAPM in explaining the excess rate of return. Other studies tested the validity of the assets pricing models in Emerging Markets. **Petkova (2006)** used monthly data over the period from July 1963 to December 2001, he investigates the ability of Fama & French three factor model in capturing the investment opportunity that appears in stock markets, for more specification both factors SMB and HML provide superior prediction to the excess market return and variation in this return and both factors highly correlated with these opportunity and provide better explanation to the time- series variation to the stocks rate of return, but not for cross- section return. He concluded that the Intertemporal capital assets pricing model (ICAPM) that was developed by Merton (1973) provide better explanation to the cross- section over than Fama & French three factor model for his specific sample and period. **Rahaman et al. (2006)** using data from Bangladesh for the period 1999 to 2003, and using a sample from non-financial firms listed in Dhaka stock exchange, They found the stocks returns are determined not only by market beta, but also by other variables such as; firm market capitalization, firm sales, book to market value. **Homsud et al. (2009)** compared between FF three factor model and CAPM in Thailand stock market, using monthly data for 421 firms, they also found that FF model provide better explanation for stocks and Portfolios returns over CAPM.

3. Data and Methodology

3.1. Data

This study examines the performance of the Fama & French three factor model in ASE for the period from June1999 to June 2010. Amman stock market was established in March 1999 as an expansion of

Amman Financial Market (AMF) that was established in 1976. The number of listed firm in this market at the end of 2010 was 274 firms with a market value equal to 22.5 billion.

In order to obtain a suitable data analysis for the empirical estimation of the model, a set of sample selection criteria is used to select stocks included in the analysis, these criteria are:

(I) each stock should have trading record at Jun of year t-1 and on Jun of year y, and should have positive book value on December of year t-1, (FF, 1993). (II) To exclude the extremely thinly traded stocks, the stock should have at least three consecutive months trading record.

The monthly rate of return for each stock is calculated to run the time-series test, the monthly rate of return for each stock in the sample is calculated as follows

$$RJ_t = ((PJ_t - PJ_{t-1}) / PJ_{t-1}) + DJ_t \quad (1)$$

Where:

RJ_t : is the rate of return of stock J at month t. PJ_t : is the average daily closing price of the stock J at month t. PJ_{t-1} : is the average daily closing price of the stock J at month t-1. DJ_t : is the dividend yield of stock J at month t. All of the information about the book value for the firms and the dividend has been obtained from the monthly statistical bulletin that is published by ASE. In order to calculate the rate of return for the market, this study used the value weighted index for ASE as proxy for the market portfolio rate of return, using the same equation the market rate of return is calculated. This study use the Three month treasury bills as a proxy for the risk free rate of return.

3.2. Methodology

In order to construct the three factors model, a two stages procedure was developed; the first stage involves the construction of the independent variables, and the second stage involves the construction of the dependant variables (portfolios). The current study uses similar constructing mimicking used by Fama and French (1993) to construct the SMB and HML factors.

3.2.1. The Model

To achieve the study objectives, the following time-series regression is used

$$R_{pt} - R_{ft} = \alpha_0 + \beta_1 [R_{mt} - R_{ft}] + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon \quad (2)$$

Where

R_{pt} = the realized return on portfolio at month t R_{ft} = is the risk free rate at month t. α_0 = the intercept. R_{mt} = the realized return on the market at month t. SMB_t = the difference in returns on small firms and large firms during time period t. HML_t = the difference in returns of firms with high book-to-market value (B/M) ratios and the returns of firms with low B/M ratios. $\beta_1, \beta_2, \beta_3$: sensitivity associated with each corresponding factor. ε : is the error in estimation.

3.2.2. Portfolios Construction Procedures

In order to construct the SMB and HML factors, this study used similar constructing mimicking that used by Fama and French (1993), in June of each year (t) all stocks on the study sample are ranked based on the firm size (average daily closing price times the shares outstanding) stocks are assigned into two portfolios of size (Small (S) and Big (B)) based on split point which is 50%, that means the highest 50% stocks are the big and the lowest 50% stocks are the small.

SMB (small minus big) is the difference each month between the simple average rate of return on the three small stocks portfolios (SL, SM, and SH) and the simple average rate of return on the three big stocks portfolios (BL, BM, and BH). (FF, 1993).

$$SMB = ((SL - BL) + (SM - BM) + (SH - BH)) / 3 \quad (3)$$

The same stocks are independently resorted into three portfolios based on the book to market equity ratio at December of year t-1, Based on the break point for the bottom 30 % (Low), middle 40% (Medium), and top 30% (High), based on the intersection between two market capitalization groups (S&B) and three Books to market equity groups (L, M and H).

HML (high minus low) is the difference each month between the simple average rate of return on two high book to market equity stocks portfolios (SH and BH) and the simple average rate of return on the two low book to market equity stocks portfolios (SL and BL). (FF, 1993)

$$HML = ((SH - SL) + (BH - BL)) / 2 \quad (4)$$

Six value weighted portfolios are constructed (SL, SM, SH, BL, BM, BH) stocks with small market value and low book-to-market ratio assigned into (SL) portfolio and so on. The value weighted monthly rate of return on the six portfolios is calculated each month over the twelve month following portfolios constructed.

In the second stage **Davis et al.** (2000) procedure is used in order to calculate the dependent variables (rate of return for the stocks). Nine portfolios are formed in the same way the six portfolios of book to market equity portfolios were formed. In June of each year (t) all stocks in the study sample are sorted by the size (average daily closing price times the shares outstanding) and distributed into three size quintiles groups (S, M, B) by allocating equal number of stocks for each group, in other word, the smallest third goes to smallest group, the second third goes to medium group and the highest third goes to big group. The same stocks are independently resorted into three portfolios based on the book to market equity ratio as of December of year t-1, and distributed into three books to market equity ratios quintiles groups (L, M, and H). Nine portfolios are formed (SL, SM, SH, ML, MM, MH, BL, BM, and BH) as the intersection of three size and three BE/ME groups, for example, the SL portfolio is comprised of stocks in the smallest third of firms and the lowest third of book to market equity ratio. The value weighted monthly rate of return on the nine portfolios is calculated from July of year y to June of year t+1.

Table (1-1) reported the number of stocks for the six portfolios constructed to run the time-series regressions.

Table (1-1): Number of Stocks in Six Portfolios Formed Based on the Intersection between the Size and Book to Market Equity Ratio.

Year	SL	SM	SH	BL	BM	BH	Total
2000-2001	9	19	29	25	27	5	114
2001-2002	11	20	29	25	28	7	120
2002-2003	8	23	30	28	26	6	121
2003-2004	7	27	25	28	21	11	119
2004-2005	7	29	32	33	25	9	135
2005-2006	8	28	35	34	29	7	141
2006-2007	7	30	40	39	32	7	155
2007-2008	8	34	43	40	35	9	169
2008-2009	19	31	41	35	42	14	182
2009-2010	21	39	42	41	42	20	205
Average	10.5	28	34.6	32.8	30.7	9.5	146.1

Source: Calculated by the researchers. SL: Portfolio of stock with small market capitalization and low book-to-market ratio SM: Portfolio of stock with small market capitalization and medium book-to-market ratio .SH: Portfolio of stock with small market capitalization and high book-to-market ratio .BL: Portfolio of stock with big market capitalization and low book-to-market ratio .BM: Portfolio of stock with big market capitalization and medium book-to-market ratio .BH: Portfolio of stock with big market capitalization and high book-to-market ratio.

4. Empirical Results

4.1. Summary Statistics

To conduct OLS stationary test is required, therefore the Augmented Dickey-Fuller was used, table (1-2) reports the result for this test.

Table (1-2): Stationarity test using Augmented Dickey--Fuller test

Stationarity test using Augmented Dickey--Fuller test book to market equity						
Size	A DF t-Statistic			Test critical values*		
	Low	Medium(M)	High(H)	Low	Medium(M)	High(H)
Small(S)	-8.97	-6.75	-7.53	-2.89	-2.89	-2.89
Medium(M)	-7.05	-8.31	-8.42	-2.89	-2.89	-2.89
Big(B)	-8.04	-7.34	-8.24	-2.89	-2.89	-2.89
RM-RF		-6.50			-2.89	
SMB		-8.44			-2.89	
HML		-7.27			-2.89	

*At 5%level

Brooks (2008) argues that conducting regressions with non-stationary data leads to spurious regressions.

Table (1-3) shows the average monthly rate of return for these portfolios and the standard deviation for dependent variables.

Table (1-3): Average Monthly Rate of Return and Standard Deviation for Dependent Variables (Nine portfolios).

BOOK TO MARKET EQUITY						
Size	Means			Standard Deviations (Sharpe Ratio)		
	Low	Medium(M)	High(H)	Low	Medium(M)	High(H)
Small(S)	0.63	1.77	2.73	5.73	5.72	6.46
Medium(M)	0.67	1.24	2.11	4.57	5.69	7.79
Big(B)	0.50	1.91	1.89	6.35	7.22	8.16

Source: Calculated by the researchers

Table (1-3) shows that portfolios with small market capitalization outperform the big market capitalization portfolios, it also documents a strong and positive relationship between average rate of return and book-to market equity ratio, the three small portfolios (SL, SM, SH) generated on average higher rate of return than three big portfolios (BL, BM, BH) by 0.83% on average, also the three portfolios with high book to market equity (SH, MH, BH) generated (on average) a rate of return that is 4.93% higher than the return generated by those low book to market equity (SL, ML, BL) portfolios. This result provides evidence supporting the size and value effect in Amman stock exchange. And are consistent with Fama and French (1993) results in US market and **Drew et. al (2003)** in Shanghai stock market. These results show positive relationship between average rate of return and (BV/MV) indicating that investors reflect the risk faced by value effect through demanding higher adjusted return.

Table (1-4) shows the statistical description for the explanatory Variables of the time-series regression.

Table (1-4): Summary statistics and correlations between the three factors monthly returns (Rm-Rf, SMB and HML) period (N =120).

	Rm-Rf	SMB	HML
Panel A			
Mean (%)	0.94	0.35	1.62
Standard deviation (%)	5.78	4.38	5.42
t(mean)	1.78	0.89	3.29
Panel B			
Rm-Rf	1		
SMB	-0.55	1	
HML	0.16	-0.14	1

Source: Calculated by the researcher

Rm –Rf: is the market risk premium, SMB: is the difference in rate of return between portfolios with small market capitalization and the portfolios with big market capitalization, HML: is the difference in rate of return between portfolios with high book to market equity ratio and portfolios with low book to market equity ratio, t (mean): is the mean rate of return divided by its standard error (Standard Deviation/119[^].5).

Panel A of Table (1-4) reporters the average monthly rates of return and the standard deviation for explanatory variables (Rm-Rf, SMB and HML) including in the regression model for Amman stock exchange market, it is shows that the HML factor (value premium) has the highest average excess rate of return and has a reliable value premium in return (1.62 percent per month, $t = 3.29$). This indicated that there is a strong value premium in rate of return, and this result consistent with **Davis et al.**(2000) the market risk premium came next to the value premium followed by SMB. Table (1-4) Panel B reported the correlation coefficients between the explanatory variables, as the rule of thumb, the independent variables should not be correlated or at least the correlation between independent variables should be low. However, the correlation coefficients between size risk premium (SMB) and market risk premium (Rm-Rf) is ($\rho = -0.55$), Thus, value to ρ indicated that the (SMB) and (Rm-Rf) variables are both highly negatively correlated which implies that the variation in (Rm-Rf) variable have a strong effect in the SMB variable estimation, the lowest correlation observed between (HML) and (SMB) variables.

4.2 Regression Results

4.2.1. The CAPM Test

Table (1-5) reports the estimation result of the single factor model.

Table (1-5): The CAPM Test: the Excess Rates of Return on the Nine Portfolios are the Dependent Variables and the Market Risk Premium is the Independent Variable.

Single Factor Model, CAPM						
$R_p - R_f = a + \beta_1 (R_m - R_f) + \varepsilon$						
	Book-to-Market ratio			Book-to-Market ratio		
	Low	Medium(M)	High(H)	Low	Medium(M)	High(H)
Portfolio		Intercept			t-statistic	
Small(S)	0.34	1.25*	2.15*	0.67	2.83	4.28
Medium(M)	0.24	0.71	1.32*	0.70	1.64	2.33
Big(B)	-0.35	1.01*	1.00**	-1.05	2.34	1.78
Portfolio		b			t-statistic	
Small(S)	0.31*	0.55*	0.62*	3.57	7.29	7.15
Medium(M)	0.46*	0.56*	0.84*	7.68	7.43	8.58
Big(B)	0.90*	0.96*	0.95*	15.72	13.03	9.79
Portfolio		Adjusted R^2			s(e)	
Small(S)	0.10	0.30	0.30	5.47	4.77	5.42
Medium(M)	0.33	0.31	0.38	3.75	4.71	6.14
Big(B)	0.67	0.59	0.44	3.63	4.64	6.09

Source: Calculated by the researchers

The intersection between small size and low book to market equity precede (SL) portfolios and so on..

* Significant different from zero at the 5% level.

** Significant different from zero at the 10% level.

The above table reports the result of the (CAPM) test. The table shows that the market risk premium coefficients are significant for all portfolios (SL, SM, SH, ML, MM, MH, BL, BM, and BH) at $\alpha = 5\%$, but these market risk premium coefficients gives incorrect direction to the excess rate of return for the portfolios that reported in the table(1-3). The market beta coefficients indicates that the biggest portfolios are more risky than the small portfolios at the same level of the intersection with book to market equity and these big portfolios should generates average rate of return exceed the rate of return generated by small portfolios. However these results contradict the results in table (1-3), even though, the medium portfolios coefficients gives the same indication (SM and SH) portfolios, these evidence can reduce the ability of the single factor model (CAPM) in explaining the monthly excess rate of return in Amman stock market, this is because: (i) The value-weighted index which is used in this study as proxy for market return (RM) is biased to the big firms(stocks) or (ii) the CAPM assumptions like the assumption about short selling and other assumptions which are not applied in

Amman stock market, This evidence is consistent with **Malin and Veeraraghavan (2004)** in European markets **Al-khazali (2001)** in Jordan.

4.2.2. The Fama & French Three-Factor Test

Table (1-6) reports the estimation results of the three factors ($(R_m - R_f)$, SMB, and HML).

Table (1-6): Fama and French Three-Factor test: the Excess Rates of Return on the Nine Portfolios are the Dependent Variables and Three Factors are the Independent Variables.

Fama & French Three-Factor Model						
$R_p - R_f = \alpha + \beta_1 (R_m - R_f) + \beta_2 \text{SMB} + \beta_3 \text{HML} + \varepsilon$						
	Book-to-Market ratio			Book-to-Market ratio		
	Low	Medium(M)	High(H)	Low	Medium(M)	High(H)
Portfolio		Intercept			t-statistic	
Small(S)	0.17	0.61	0.83*	0.32	1.41	2.13
Medium(M)	0.09	0.01	0.27	0.24	0.01	0.51
Big(B)	0.31	0.86**	0.32	0.99	1.98	0.62
Portfolio		β_1			t-statistic	
Small(S)	0.40*	0.70*	0.79*	3.84	8.24	10.38
Medium(M)	0.59*	0.66*	0.88*	8.51	8.07	8.63
Big(B)	0.81*	0.83*	0.79*	13.54	9.82	7.81
Portfolio		β_2			t-statistic	
Small(S)	0.22	0.42*	0.62*	1.58	3.79	6.21
Medium(M)	0.29*	0.36*	0.29*	3.26	3.34	2.20
Big(B)	-0.32*	-0.24*	-0.18	-4.08	-2.15	-1.34
Portfolio		β_3			t-statistic	
Small(S)	0.00	0.22*	0.57*	0.04	2.85	8.37
Medium(M)	-0.04	0.29*	0.56*	-0.68	3.98	6.15
Big(B)	-0.28*	0.22*	0.55*	-5.20	2.87	5.99
Portfolio		Adjusted R^2			s(e)	
Small(S)	0.12	0.40	0.62	5.46	4.42	3.99
Medium(M)	0.38	0.43	0.53	3.61	4.31	5.32
Big(B)	0.75	0.62	0.58	3.14	4.43	5.31

Source: Calculated by the researcher

The intersection between small size and low book to market equity precede (SL) portfolios and so on.

* Significant different from zero at the 5% level. ** Significant different from zero at the 10% level.

The results reported in table (1-6) are consistent with the result reported in table (1-5), the market risk premium coefficients. However the market risk premium coefficient do not have the ability to explain the variation in rate of return for six portfolios, it is suggest that the (BL) portfolios is more risky than (SL) portfolios should generate rates of returns exceed the rate of return for that generated by (SL) portfolio and the same thing for the (SH) and (BH) portfolios. The SMB factor (size risk premium) coefficients are significant in all portfolios at $\alpha = 5\%$ except the (SL) and (BH) portfolios, the coefficients for SMB factor becomes higher when moving to higher book to market equity portfolios. For HML factor (Value risk premium), the HML coefficients are significant in all portfolios at $\alpha = 5\%$ except the (SL) and (ML) portfolios. The results presented in table (1-6) are consistent with the result in table (1-3) for the size and value effect in Amman stock exchange. The increase in the coefficients for SMB and HML reflect the variation in the rate of return among portfolios. The results about size effect and value effect and the variation in rate of return are consistent with the finding **Banz (1981)** and **Berk (1995)** and **Haugen (1995)** in the US markets .However, if we compare the ability of the (SMB) and (HML) factors to reflect the difference in rate of return between small and big portfolios, the results in table (1-6) suggests that both factors have the same ability to reflect the variation in rate of return between small and big portfolios. The results reported for the adjusted R^2 range from 12% to 75%. The lowest of 12% is for the portfolio with the smallest market capitalization and lowest book to market equity. The adjusted R^2 s has a trend to increase with the increase in market capitalization. Table (1-6) shows that the three factor model can provide better explanation to the big

portfolios relative to small portfolios. Comparing the results of the three factor model with those of CAPM, the Fama & French three factor model provide better explanation to the variation in stocks rate of return. Comparing the adjusted R^2 s for the CAPM and the Fama & French three factor model, for all portfolios, the three factor model adjusted R^2 s higher than the adjusted R^2 s for the CAPM and the standard errors of the estimations are higher $s(e)$ for the CAPM higher than in the three factors model; as example the adjusted R^2 s that the CAPM was provided for the (BL) portfolio is 67% while the adjusted R^2 s that the FF three factors model was 75%. These evidence indicated that the Three-factor model provide a better explanation to the variation in stocks rate of return than the CAPM. These evidences are consistent with evidence that found by **Griffin (2002)** in Japan, United Kingdom and Canada, **Connor and Sehgal (2001)** in India stock markets.

5. Summary and Conclusions

The main objective of this study is to test the ability of the Fama - French three factor model to explain the variation in stocks rate of return. The study also investigates the existence size and value in ASE, over the period from June 1999 to June 2010, based on the result that are found in the table (1-3), this study observed a strong size and value effects in Amman stock exchange.

Based on the result that found in the tables (1-5) this study does not found any evidence that support the ability of the single factors model (CAPM) to provide suitable explanation to the variation in portfolios rates of return, also the CAPM incapable to predict the variation in rats of return between different portfolios, in the most cases the market risk premium coefficient, its asserts that higher-beta-risk assets should carry higher expected rate of return, which in contrary in the result that found for the most portfolios, the market risk premium coefficient indicated that the big portfolios are more risky and should have higher rate of return than the small portfolios because the coefficients for big portfolios are than the coefficients for small portfolios. Based on the result that found in the tables (1-6) this study found that the Fama & French three factor model have the ability to provide better explanation to the variation in the stocks rate of return over CAPM, also the three factors model have superior power to predict the portfolios rates of return over the single factor model (CAPM), for more specification the both factors (SMB and HML) added to the explanatory power to the single factor model, but the (HML) factor have more constant relation with the portfolios rate of return in the all methodology that used to test the three factors model.

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